

CLAIMS

1. A photovoltaic cell structure comprising:
a p-n junction formed on one or more regions of a solar cell material layer,
wherein the solar cell material layer is removed from a support layer.
2. The photovoltaic cell as in claim 1, wherein the solar cell material layer and the support layer are essentially the same material.
3. The photovoltaic cell as in claim 1, wherein the solar cell material layer is bonded to the support layer prior to formation of the p-n junction.
4. The photovoltaic cell as in claim 1, wherein the solar cell material layer is selectively bonded to the support layer prior to formation of the p-n junction.
5. A photovoltaic cell set comprising a first photovoltaic cell as in claim 1 and a second photovoltaic cell as in claim 1, each photovoltaic cell including a solar capture surface, a back surface, a first distal side and a second distal side, wherein the first distal side of the solar capture surface of the first photovoltaic cell is bonded to the second distal side of the back surface of the second photovoltaic cell.
6. The photovoltaic cell set as in claim 5, further comprising a third photovoltaic cell, wherein the first distal side of the solar capture surface of the second photovoltaic cell is bonded to the second distal side of the back surface of the third photovoltaic cell.
7. A method of manufacturing a photovoltaic cell comprising:
bonding a photovoltaic cell layer to a substrate layer at selective locales to define one or more regions of weak bonding and one or more regions of strong bonding;
processing one or more photovoltaic cells in the one or more regions of weak bonding.

8. The method as in claim 7, further comprising removing the one or more photovoltaic cells by debonding the one or more regions of strong bonding.

9. The method as in claim 8, further comprising removing a layer of the substrate layer and bonding the removed layer of substrate to the remaining substrate layer at selective locales to define one or more regions of weak bonding and one or more regions of strong bonding, thereby recycling the substrate layer.

10. A method of manufacturing a photovoltaic cell comprising:
providing a multiple layered substrate having a device layer and a substrate layer, the device layer selectively bonded to the substrate layer to define one or more regions of weak bonding and one or more regions of strong bonding;

processing one or more photovoltaic cells in the device layer at one or more regions of weak bonding;

removing the device layer from the substrate layer by debonding the strong bond regions, thereafter allowing removal of the device layer with minimal or no damage to the processed photovoltaic cells in the device layer.

11. The method of claim 7 or claim 10, wherein the photovoltaic cell comprises a cell selected from the group consisting of p-n junction, back surface field, violet; textured, V-groove multijunction, organic, photosynthesis based energy conversion, and combinations comprising at least one of the foregoing.

12. A method of manufacturing a photovoltaic cell comprising:

providing a first multiple layered substrate having a first device layer and a first substrate layer, the first device layer selectively bonded to the first substrate layer to define one or more regions of weak bonding and one or more regions of strong bonding;

processing a first photovoltaic cell in the first device layer at one or more regions of weak bonding;

removing the first device layer from the first substrate layer by debonding the strong bond regions, thereafter allowing removal of the first device layer with minimal or no damage to the processed photovoltaic cells in the first device layer;

providing a second multiple layered substrate having a second device layer and a second substrate layer, the second device layer selectively bonded to the second substrate layer to define one or more regions of weak bonding and one or more regions of strong bonding;

processing a second photovoltaic cell in the second device layer at one or more regions of weak bonding;

removing the second device layer from the second substrate layer by debonding the strong bond regions, thereafter allowing removal of the second device layer with minimal or no damage to the processed photovoltaic cells in the second device layer; and

stacking and bonding the first device layer to the second device layer at a distal edge of the layers to form a photovoltaic cell set.

13. A method of manufacturing a tandem photovoltaic cell comprising:
providing a first photovoltaic cell formed according to the method of claim 7,
10 or 12, having a bandgap $E_g(1)$; and

stacking a second photovoltaic cell formed according to the method of claim
7, 10 or 11, having a bandgap $E_g(2)$, atop the first photovoltaic cell, wherein $E_g(1)$ is
greater than $E_g(2)$, thereby providing a tandem photovoltaic cell.

14. The photovoltaic cell as in claim 4, wherein the selective bonding
comprises regions of weak bonding and regions of strong bonding, wherein the p-n
junctions are formed in the regions of weak bonding on the solar cell material layer,
whereby the solar cell material layer is debonded from the support layer by processing
the strong bond regions and minimally invading the weak bond regions, further
whereby the photovoltaic cell formed in the weak bond region required little or no
repair subsequent debonding.